azbil

No. CP-SP-1190E

TM

MVF Series
Micro Flow Vortex Gas Flowmeter
User's Manual

Thank you for purchasing an MVF Series flowmeter.

This manual contains information for ensuring the correct use of the MVF Series flowmeter. It also provides necessary information for installation, maintenance, and troubleshooting.

This manual should be read by those who design and maintain equipment that uses the MVF Series flowmeter. Be sure to keep this manual nearby for handy reference.

Yamatake Corporation

RESTRICTIONS ON USE

This product has been designed, developed and manufactured for general-purpose application in machinery and equipment.

Accordingly, when used in applications outlined below, special care should be taken to implement a fail-safe and/or redundant design concept as well as a periodic maintenance program.

- Safety devices for plant worker protection
- Start/stop control devices for transportation and material handling machines
- Aeronautical/aerospace machines
- Control devices for nuclear reactors

Never use this product in applications where human safety may be put at risk.

NOTICE

Be sure that the user receives this manual before the product is used.

Copying or duplicating this user's manual in part or in whole is forbidden. The information and specifications in this manual are subject to change without notice.

Considerable effort has been made to ensure that this manual is free from inaccuracies and omissions. If you should find an error or omission, please contact Yamatake Corporation.

In no event is Yamatake Corporation liable to anyone for any indirect, special or consequential damages as a result of using this product.

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SAFETY PRECAUTIONS

■ About Icons

The safety precautions described in this manual are indicated by various icons. Please be sure you read and understand the icons and their meanings described below before reading the rest of the manual.

Safety precautions are intended to ensure the safe and correct use of this product, to prevent injury to the operator and others, and to prevent damage to property. Be sure to observe these safety precautions.

⚠**WARNING**	Warnings are indicated when mishandling this product might result in death or serious injury.
⚠**CAUTION**	Cautions are indicated when mishandling this product might result in minor injury to the user, or only physical damage to the product.

■ Examples

	Triangles warn the user of a possible danger that may be caused by wrongful operation or misuse of this product. These icons graphically represent the actual danger. (The example on the left warns the user of the danger of electric shock.)
	White circles with a diagonal bar notify the user that specific actions are prohibited to prevent possible danger. These icons graphically represent the actual prohibited action. (The example on the left notifies the user that disassembly is prohibited.)
	Filled-in black circles instruct the user to carry out a specific obligatory action to prevent possible danger. These icons graphically represent the actual action to be carried out. (The example on the left instructs the user to remove the plug from the outlet.)

⚠WARNING

❗	**If this device is used with flammable gases such as natural gas, propane or butane, mount it on the upstream side of the safety shutoff valve.** **When air gets in the pipe and an explosive mixture is produced, and if a sensor should make a spark due to lightning or other reasons, the mixture may explode inside the pipe.**
❗	**The mass of this device is 7 to 23kg according to the model number. Ensure to take complete precautions and care while handling for transportation or installation. For safe handling, two or more persons are required while handling this device.** **Accidental dropping of the device on the foot might cause injury.**
⃠	**Do not hold the device by the converter alone. Doing so might damage the device, or the pipe connector section may drop off.**
⃠	**Do not use this device or its installed pipes as a scaffolding.** **Doing so might damage the device or the pipe, or might cause physical injury.**
⃠	**Do not disassemble this device.** **If it is disassembled when pressure remains in the pipes, the device could be damaged or someone could be injured by flying parts.**

⚠CAUTION

❗	**Be sure that the operating gas temperature does not fall below -15°C. Using the gas below -15°C, the O-ring might crack and cause gas leakage.**
❗	**Prevent foreign matter from entering the device.** **If the rust, water droplet, oil mist or dust in the piping flows into the device, measurement error might occur and result in damaging the device.** **If there is a possibility that any foreign matter flows into the device, provide a filter, strainer or mist trap capable of eliminating more than 1μm foreign matter at the upstream, and periodically inspect and replace the filter.**
❗	**If this device is used for monitoring flowrate of the burner, consider the piping instrumentation lest the backfire damage this device.**
❗	**When connecting the load to the output terminals, do not exceed the rated value shown in the specifications.** **Doing so might cause the damage of this device.**

⚠CAUTION

	This device is a precision instrument. Do not drop it or subject it to shock. Doing so might damage the device.
	When connecting flanges, tighten with the specified torque. Otherwise gas could leak from the pipe, causing injury.
	When mounting the device, firmly fasten to prevent vibration.
	Do not peel off the pipe connector port seals until immediately before you connect the piping. Doing so might allow foreign objects to enter the connector port and cause defective operation.
	Do not flush when the device is mounted in the pipe. Doing so might cause damage due to entry of foreign matter and cause faulty operation or errors in measurement.
	Before wiring, be sure to turn the power OFF.
	Before supplying power, be sure to check that there is no wiring error. A wiring error might damage the device or cause a dangerous condition.
	Do not use this device outside of the operating pressure range. Also, do not subject this device to a pressure above the pressure resistance. Doing so might damage this device.

Organization of This User's Manual

This manual is organized as follows:

Chapter 1. INTRODUCTION

This chapter describes features on this device.

Chapter 2. NAMES AND FUNCTIONS OF PARTS

This chapter describes the NAMES AND FUNCTIONS OF PARTS on this device.

Chapter 3. INSTALLATION, MOUNTING, WIRING

This chapter describes installation, mounting and wiring on this device.

Chapter 4. TROUBLESHOOTING

This chapter describes how to investigate and remedy trouble that may occur during operation of this device.

Chapter 5. SPECIFICATIONS

This chapter describes the specifications and external dimensions of this device.

Conventions Used in This Manual

The following conventions are used in this manual:

Handling Precautions:
Handling Precautions indicate items that the user should pay attention to when handling the MVF Series.

Note: Notes indicate information that might benefit the user.

☞: This indicates the item or page that the user is requested to refer to.

(1), (2), (3): Numbers within parentheses indicate steps in a sequence or parts of an explanation.

RLOI:
1000.0 This indicates 7-segment indication on the display.

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Chapter 1. INTRODUCTION

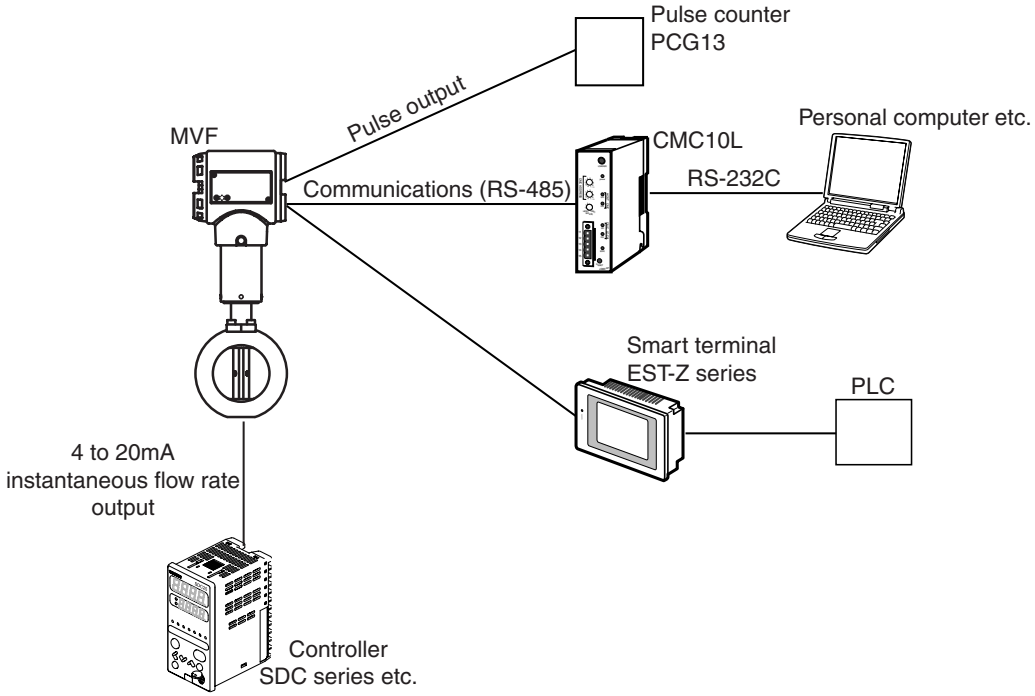
■ Introduction

The MVF Series Micro Flow Vortex Gas Flowmeter (hereafter called "the device" or "the MVF") is a thermal vortex gas flowmeter featuring a wide measurement range. It uses the Yamatake-designed Micro Flow sensor (or "μF sensor") as a vortex generator.

■ Features

- 35% more of the MVF's component materials are available for re-use or recycling, as compared with the conventional CMK model.
- Temperature and pressure compensation functions are integrated into the MVF. Since expensive temperature and pressure compensation devices are not required, a large cost reduction can be expected.
- This device incorporates a μF (Micro Flow) sensor a mere 1.7mm square and 0.5mm thick, made possible by silicon micro-machining and thin-film technologies. By using this high-sensitivity, high-speed sensor to detect vortex frequency, measurement rangeability of 100:1 has been achieved.
- The entire MVF is provided with wide range of functions to meet various applications needs: LCD display function, analog output (4 to 20mA), integrating calculation, display and integral pulse output (open collector).
  Also, an RS-485 communications function is provided as a standard feature, so a large amount of instrumentation cost reduction can be achieved when data is uploaded.

■ System



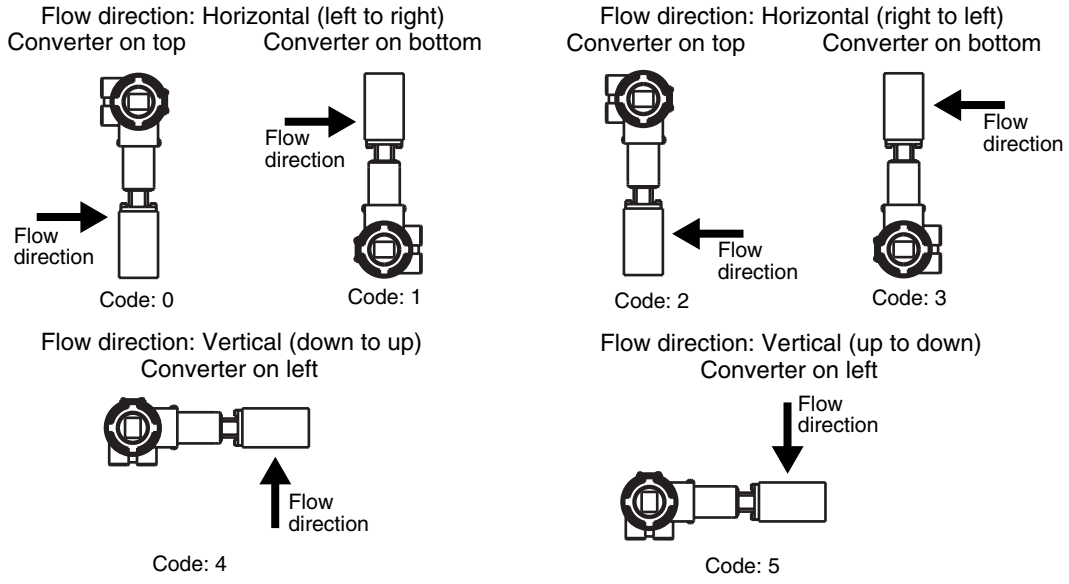
■ Model selection table

The following shows the model Nos. for this flowmeter:

Basic model No.	Pipe size	Model type	Material	Connecti-on method	Gas type	Output	Power	Commu-nication	Flow and moun-ting direction	Option 1	Option 2	Appended	Descripton
MVF													Micro Flow Vortex Flowmeter
	050												Pipe size 50A (2B)
	080												Pipe size 80A (3B)
	100												Pipe size 100A (4B)
	150												Pipe size 150A (6B)
		0											With temperature/pressure compensation function
		L											Without pressure compensation but with temperature compensation
			S										Material SUS304
				U									JIS/ANSI wafer
					N								Air, Nitrogen, Algon
					S								Oxygen (Be sure to specify code "1" in the opiton 1 gas-contacting parts treated to be oil free) *1
					C								Carbondioxide
					G								Natural gas (LNG base), Methane
					P								Propane
					B								Butane
						0							4 to 20mAdc output + Integration pulse output
							1						Power 24Vdc
								1					RS-485 Communication (EST, WEB100, CMC10G communication)
									0				Horizontal (Flow direction:left to right) Converter on top *2
									1				Horizodntal (Flow direction:left to right) Converter on bottom *2
									2				Horizontal (Flow direction:right to left) Converter on top *2
									3				Horizontal (Flow direction:right to left) Converter on bottom *2
									4				Vertical (Flow direction:down to up) Converter on left *2
									5				Vertical (Flow direction:up to down) Converter on left *2
										0			Option 1 none
										1			Gas-contacting parts treated to be oil free (Necessary if gas type is oxygen) *1
											0		Option 2 none
												0	Product version

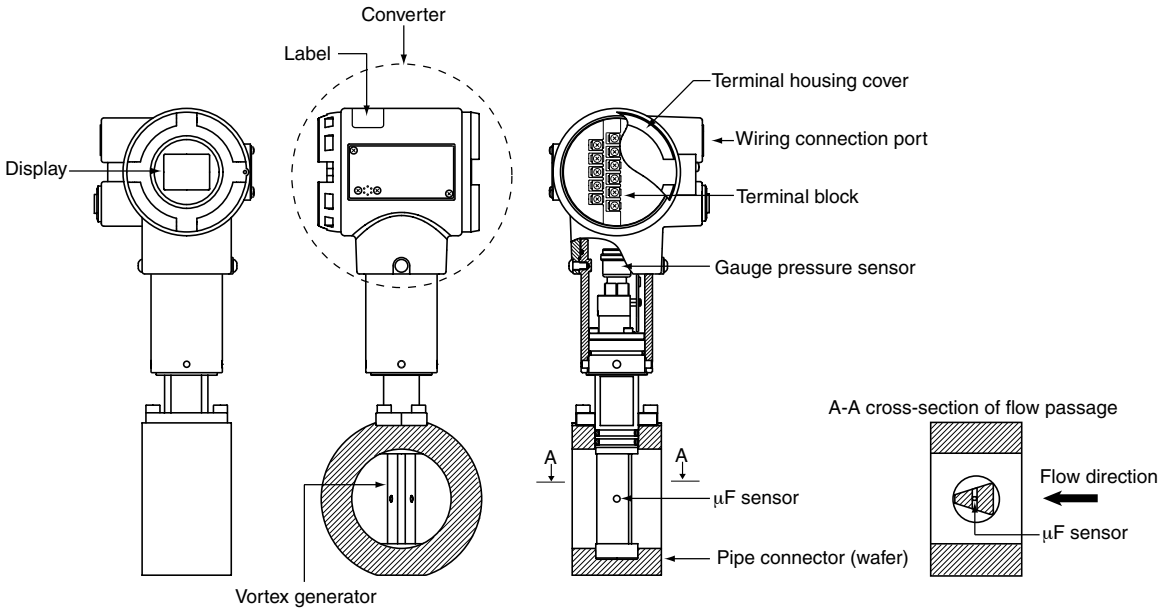
*1: If the gas type is oxygen, be sure to specify oil free treatment.

*2: Flow and mounting directions



Chapter 2. NAMES AND FUNCTIONS OF PARTS

■ Body



Display

Used for the display of instantaneous flow rate, integrated flow rate, and alarm status and error of this device. For details of the display, refer to; ☞■ Display (on next page).

Label

Indicates model number, range, and pulse rate. Check that they are the same as the specifications ordered.

Converter

Calculates temperature, pressure, etc.

Wiring connection port

There are 2 wiring connection ports. Used for connecting an electric wiring conduit and mounting the included waterproof gland.

Terminal block

Used for wiring a power supply to the device, for 4-20mAdc output, integrated pulse output and communications.

Gauge pressure sensor

Detects pressure.

μF Sensor

Detects vortex frequency and temperature.

Pipe connector

Wafer connection. Pipes are connected by sandwiching the pipe connector between flanges.

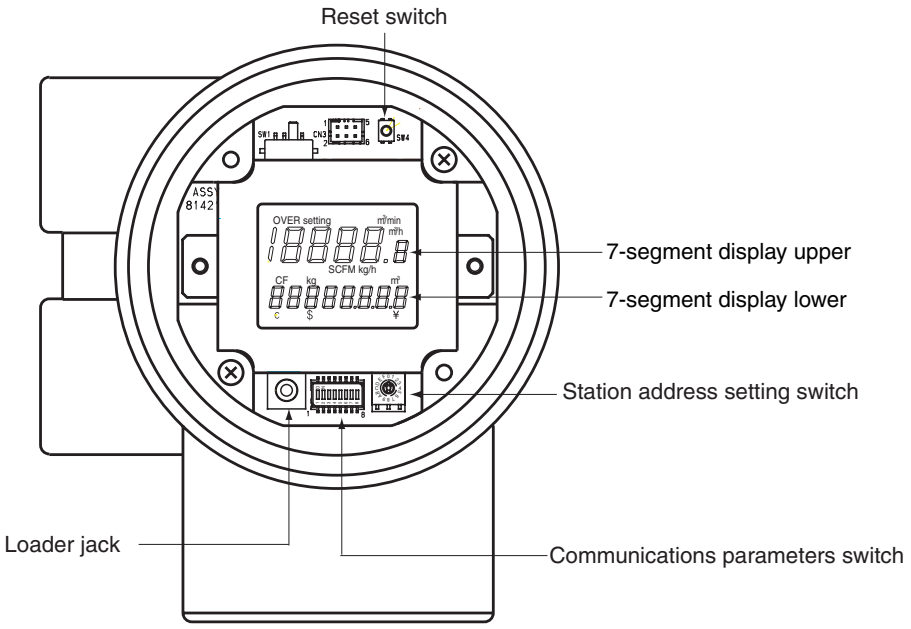
Vortex generator

Generates vortex.

■ Display

⚠CAUTION

Before pressing the reset switch, touch a metal surface such as the housing of the device to discharge static electricity.



Reset switch

This switch resets the integrated (cumulative) value. When this reset switch is pressed for 3 seconds, the integrated value is reset to 0.

Upper 7-segment display

Displays instantaneous flow rate.
(Example: 10000.0 m^3/h)

Lower 7-segment display

Displays integrated flow rate.
(Example: MVF050 1000000.0 m^3
MVF080/100/150 10000000 m^3)

Station address setting switch

This switch sets the station address for the device.
For setup details, refer to;
☞MVF Series Communications Functions (CP-SP-1183E).

Communications parameters switch

This switch sets the communications parameters for the device.
For setup details, refer to;
☞MVF Series Communications Functions (CP-SP-1183E).

Loader jack

The loader jack is used by the manufacturer when servicing the device.
Please do not try to use it.

Chapter 3. INSTALLATION, MOUNTING, WIRING

⚠WARNING

If this device is used with flammable gases such as natural gas, propane or butane, mount it on the upstream side of the safety shutoff valve.
When air gets in the pipe and an explosive mixture is produced, and if a sensor should make a spark due to lightning or other reasons, the mixture may explode inside the pipe.

The mass of this device is 7 to 23kg according to the model number. Ensure to take complete precautions and care while handling for transportation or installation. For safe handling, two or more persons are required while handling this device.
Accidental dropping of the device on the foot might cause injury.

Do not hold the device by the converter alone. Doing so might damage the device, or the pipe connector section may drop off.

Do not use this device or its installed pipes as a scaffolding.
Doing so might damage the device or the pipe, or might cause physical injury.

Do not disassemble this device.
If it is disassembled when pressure remains in the pipes, the device could be damaged or someone could be injured by flying parts.

⚠CAUTION

Prevent foreign matter from entering the device.
If the rust, water droplet, oil mist or dust in the piping flows into the device, measurement error might occur and result in damaging the device.
If there is a possibility that any foreign matter flows into the device, provide a filter, strainer or mist trap capable of eliminating more than 1µm foreign matter at the upstream, and periodically inspect and replace the filter.

This device is a precision instrument. Do not drop it nor subject it to shock. Doing so might damage the device.

When mounting the device, firmly fasten to prevent vibration.

Handling Precautions

- When connecting to the pipe, be sure to check that there is no inclination of pipes nor any pipe center line misalignment, and then install the device. Doing so might cause leakage.
- When mounting the device, firmly fasten to prevent vibration.
- The communication line must be separated from power lines, and do not lay in the same conduit.
  Doing so might cause faulty operation.

■ Installation

Avoid mounting this device in the following locations:

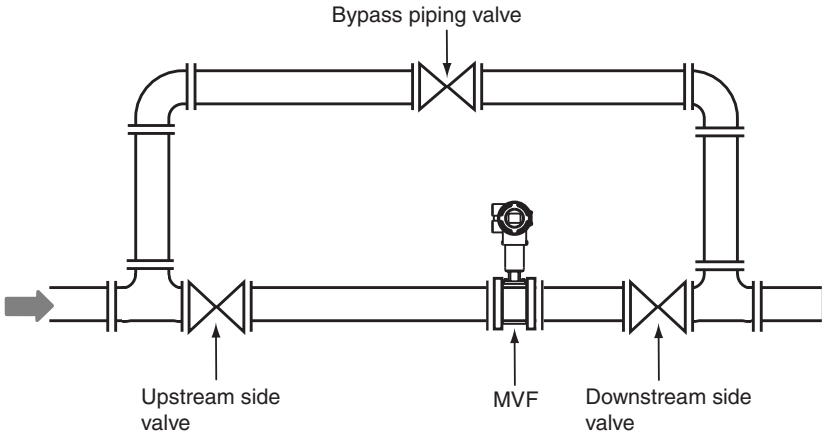
- Locations whose ambient temperature falls below -15˚C and rises above +60˚C
- Locations whose ambient humidity exceeds 90%RH
- Locations subject to sudden changes in temperature and condensation
- Locations be filled with corrosive gases and flammable gases
- Locations where there are lots of conductive substances (e.g. dust, salt or iron dust), or organic solvents
- Locations subject to vibration or shock
- Locations subject to splashing by fluids (e.g. oil, chemicals.)
- Locations where strong magnetic or electrical fields are generated

! Handling Precautions

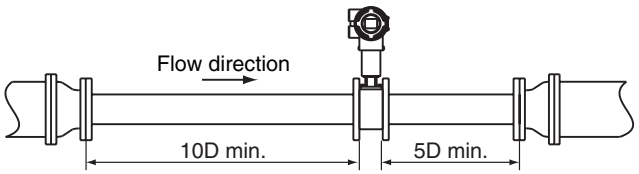
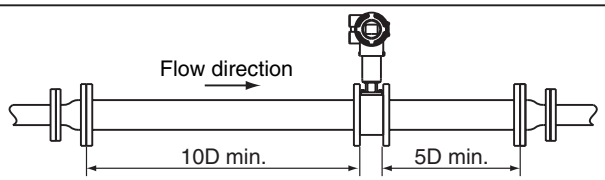
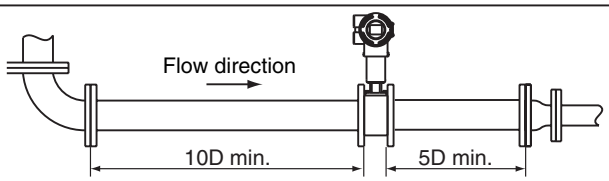
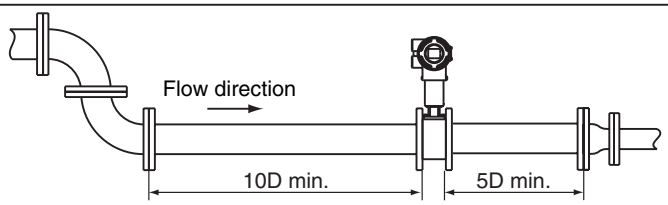
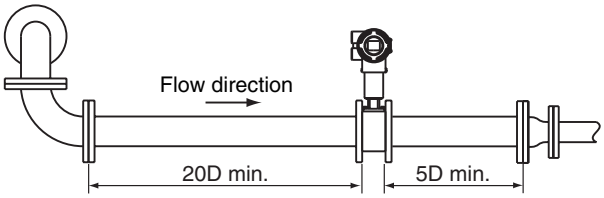
- Although this device can be installed outdoors, if it is installed at the locations subject to direct sunlight, be sure to provide a sunshade. Doing so might cause faulty operation.

■ Precautions for piping installation

- When this device is installed, be sure to provide the bypass piping as shown below.
  Also, for the valves before and after this device, use a ball valve like as having the structure which does not disturb the gas flow.



- Provide a straight pipe section in upstream side and downstream side of the installation location.
  Refer to the drawings below for the length of upstream pipe section. D indicates the connecting port size. Secure the length of more than 5D for the downstream pipe section.

Type of Installation	
Reducing pipe	
Enlarging pipe	
Pipe with 90° bend	
Pipe with single-plane double 90° bend	
Pipe with three-dimensional double 90° bend	

- If the oil, water or dust is contained in a fluid, install a device to remove them.
  If the oil, water or dust is contained in a fluid, they might cause measurement error or faulty operation.

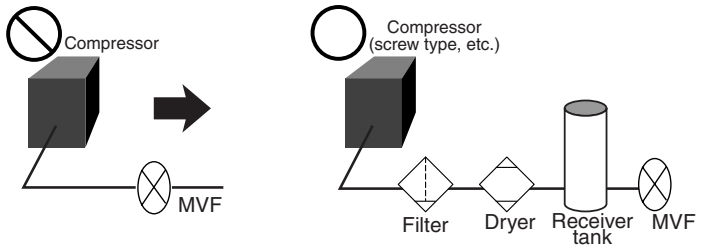
Note

- Remove the water using a dryer so that it does not cause dew condensation in the pipe.
- Use a dust-eliminating filter of less than 1μm mesh.
- Use an oil-eliminating mist separator with the eliminating capability of residual oil density less than 0.01mg/m^3.

- Do not install at a location receiving the influence of pulsating flow.

Handling Precautions

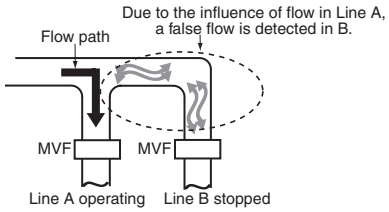
- Do not install this device at the location near the exit of compressor. At the location near the exit of compressor the strong pulsating flow is caused and there might be a dispersing of iron powder depending on the compressor type, there is a possibility of causing faulty operation.



As shown in the above figure, provide the devices eliminating the foreign matters such as oil, water and iron powder, and install a receiver tank as the measures against pulsating flow ; at the upstream of MVF series.

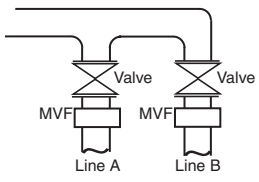
- Take effective countermeasures in case of installation near a pump or roots blower. If this device is installed near a pump or roots blower, it may be affected by a pulsating flow. Install a volume tank or pulsation-damping device (muffler) between the pump or roots blower and this device to suppress the influence of pulsation as much as possible.
- If the device is installed downstream of branched piping, it may detect reverse flow rate. Be sure to take countermeasures as illustrated below.

Example: In this application, Line A is operating but B is stopped. Although the flow rate of B is essentially zero as detected by the MVF in B, the MVF might count and integrate a false flow rate caused by the influence of the flow in Line A.



Countermeasure 1

Install a valve on the upstream side of the MVFs if there is an unused line, to eliminate the influence of flow in the other line.



Countermeasure 2.

Design the system so that other devices do not receive the output (4 to 20mA pulse) from the MVF on the unused line.

■ Piping work

⚠WARNING

The mass of this device is 7 to 23kg according to the model number. Ensure to take complete precautions and care while handling for transportation or installation. For safe handling, two or more persons are required while handling this device.
Accidental dropping of the device on the foot might cause injury.

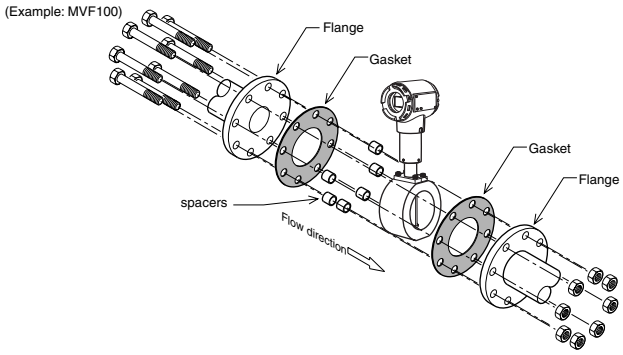
⚠CAUTION

Do not flush when the device is mounted in the pipe.
Doing so might cause damage due to entry of foreign matter and cause faulty operation or errors in measurement.

When connecting flanges, tighten with the specified torque.
Otherwise gas could leak from the pipe, causing injury.

Handling Precautions

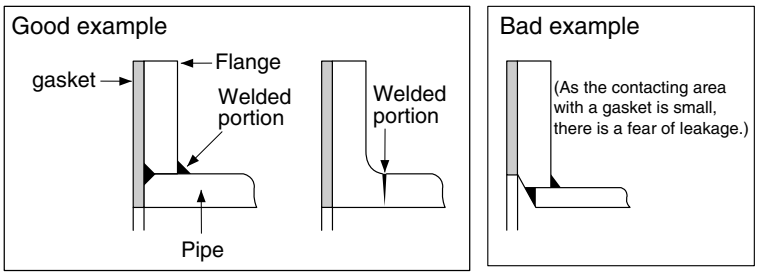
- When connecting to piping, be sure to check before installation that there is no inclination or displacement of the pipes. Failure to do so might cause leakage or measurement error.
- Be sure to flush (cleaning the inside of pipe) before installation this device to eliminate any foreign matter which might exist inside the pipe.
- When installing, pay special attention to the flow direction.



To mount this device, sandwich it between two pipe flanges (wafer mounting). Note that spacers should be used to prevent displacement during mounting. The use of spacers enables proper alignment of the piping and this device. Be sure to use the spacers.

● Flange shape

Use a flange which can secure a large contacting area with a gasket.



● Flange connection

Tighten the flange with bolts.
Tightening torque differs by pipe size. Tighten at a torque that is within the range specified in the table below.

Pipe size	Torque Unit : N • m(kgf • cm)
50A	37 to 47 (378 to 480)
80A	26 to 36 (265 to 367)
100A	32 to 42 (327 to 429)
150A	64 to 74 (653 to 755)

(The value in parentheses indicates the reference value.)

! Handling Precautions

- Tighten bolts so that they are uniformly tightened. If leakage does not stop after tightening bolts, gradually tighten the bolts more a little at a time.
- Tighten bolts within the specified tightening torque. Otherwise, the bolts may be damaged.
- Do not forcibly insert into the narrow space between the flange faces. Doing so might cause leakage or damage.
- Six of the 8 bolts on MVF080/100/150 models require the use of a spacer to ensure that the are correctly aligned around the pipe connection unit (wafer) and that they match up properly with the holes in the pipe flanges.

● Diameter of gasket

A gasket is required for flange connection.
Refer to the table below for the inside diameter of gasket.

Pipe size	Inside diameter of gasket (Reference value)
50A	61mm
80A	90mm
100A	115mm
150A	167mm

! Handling Precautions

- If the inside diameter of the gasket is too small, it might disturb the flow straightening condition inside of this device and cause inaccuracies.
- If the inside diameter is too large, it might cause leakage.

■ Wiring

⚠CAUTION

When connecting the load to the output terminals, do not exceed the rated value shown in the specifications.
Doing to do so might cause the damage of this device.

Before wiring, be sure to turn the power OFF.

Before supplying power, be sure to check that there is no wiring error. A wiring error might damage the device or cause a dangerous condition.

Handling Precautions

- Be sure to separate the communications wires from power lines, which should not be laid in the same electrical conduit.

There are two wiring methods, direct cable lead-out and use of an electrical wiring conduit.
When installing the device outdoors, be sure to use a conduit.

● Tools required

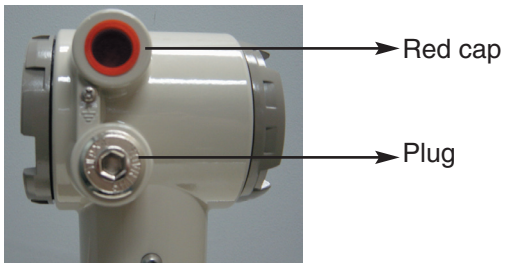
Phillips-head screwdriver, adjustable wrench (spanner)

● Procedure for direct cable lead-out

(1) Select a wiring connection port.

Handling Precautions

- There are 2 wiring connection ports. One port has a red cap and the other has a plug. Decide whether to use one port or 2 ports depending on the number of cables or desired separation of signal wires.

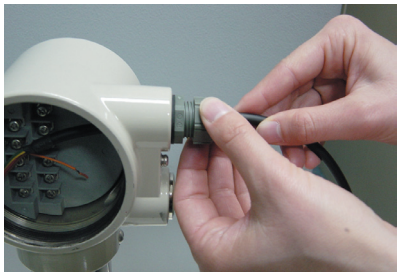


(2) Remove the red cap from the wiring connection port. When leading out the wiring from two ports, remove the plug also.

(3) Remove the terminal cover.

(4) Put the packing on the supplied waterproof gland.

(5) Pass the cable through the waterproof gland, and mount the waterproof gland in the wiring connection port.



Handling Precautions

- Never remove the packing from the waterproof gland.
- Use a cable that is 6 to 12mm in diamater.

(6) Connect the wiring to the terminal block.
(7) Put the terminal cover back in place.

● **Procedure for using an electrical wiring conduit**

The wiring connection port thread is G1/2.
(1) Select a wiring connection port.

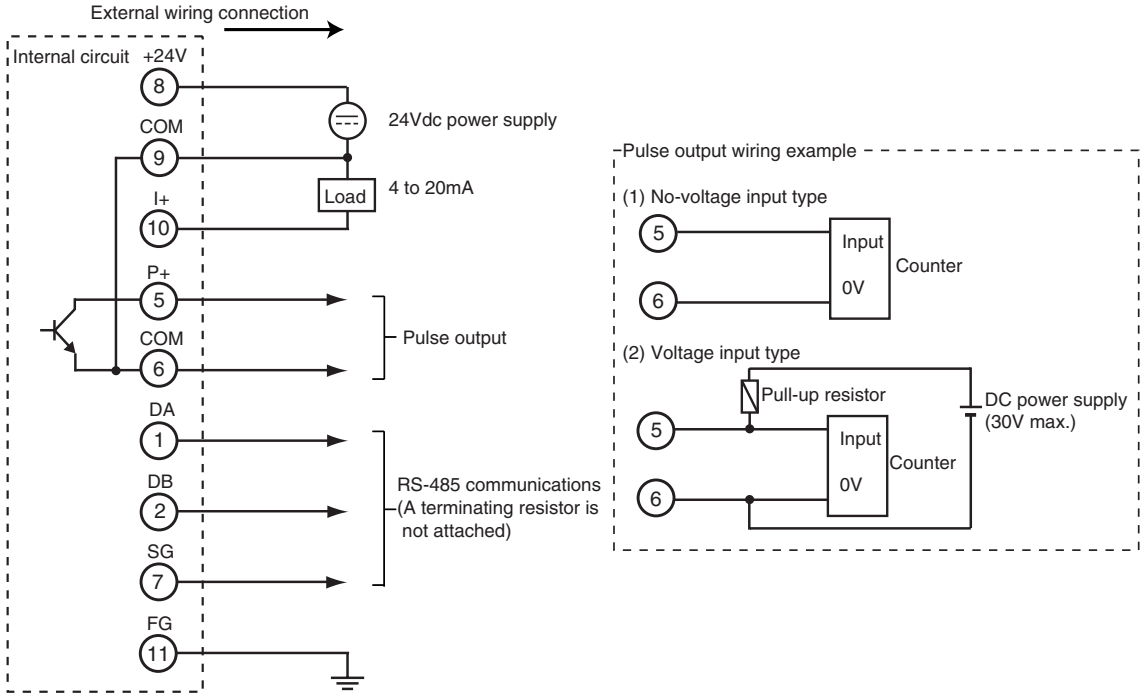
Handling Precautions

- There are 2 wiring connection ports. One port has a red cap and the other has a plug. Decide whether to use one port or 2 ports depending on the number of cables or desired separation of signal wires.

(2) Remove the red cap from the wiring connection port.

(3) When leading out the wiring from two ports, remove the plug also.
(4) Remove the terminal cover.
(5) Connect an electrical wiring conduit.
(6) Pass the wiring through the electrical wiring conduit and then connect the wiring to the terminal block.
(7) Put the terminal cover back in place.

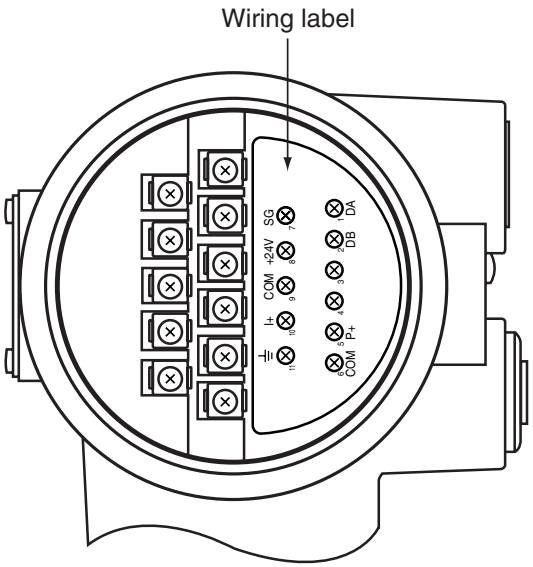
● Wiring connection example



! Handling Precautions

- Connect COM of 4-20mA output directly from the terminal block.
- Do not use the COM power supply terminal (4-20mA) or the COM pluse output terminal as a common power supply terminal for external devices.
- Be sure that the pulse output never exceeds the output rating of this device. When driving a relay, use a relay with a built-in diode for coil surge absorption. Failure to do so may cause faulty operation.

● **Terminal layout**



Terminal No.	Signal name	Description
1	DA	RS-485 communication DA
2	DB	RS-485 communication DB
3	Unused	Do not use
4	Unused	Do not use
5	P+	Pulse output (NPN open collector)
6	COM	Common
7	SG	RS-485 communication common
8	+24V	24V power
9	COM	Common
10	I+	4 to 20mA output
11	⏚	Ground terminal

⚠ Handling Precautions

- Connect each terminal securely using crimp type terminal lugs to ensure firm contact area.
- Use crimp type terminal lugs applicable to M4 screw.
- Be sure that the tightening torque of terminal screw is less than 0.8N•m.
- Use the JIS C 3401 cables for control (CVV etc.) of less than 2.2mm dia. for the wiring except RS-485 communications.
  - Use the twisted-pair shielded cables for the wiring of RS-485 communications. Be sure to apply terminating resistors (150Ω 1/2W).
    For communications of wiring details, refer to;
    ☞MVF Series Communications Functions (CP-SP-1183E).

Chapter 4. TROUBLESHOOTING

If there is a problem with this device, refer to the table below.

■ Nothing on display

Make sure that the correct power voltage being applied and the polarity are correct.
Make sure that the electric wires are connected.

■ Error message (faulty operation)

When an error message is displayed, contact Yamatake Corporation. Repair at a Yamatake facility is required.

Error message	Failure location	Cause
Er01	Flow sensor	Flow sensor error
Er02	Temperature sensor	The cause may be an error or burnout of the sensor for temperature detection. Alternatively dust, moisture or oil from the fluid may have adhered to the sensor.
Er03	Flow sensor Temperature sensor	There may be an error or burnout of the flow sensor or temperature sensor. Alternatively dust, moisture or oil from the fluid may have adhered to the sensor.
Er04	Pressure sensor	The cause may be an error or burnout of the pressure compensating sensor.
Er05	Flow sensor Pressure sensor	The cause may be an error or burnout of the flow sensor or pressure sensor. Alternatively dust, moisture or oil from the fluid may have adhered to the sensor.
Er06	Temperature sensor Pressure sensor	The cause may be an error or burnout of the temperature sensor or pressure sensor. Alternatively dust, moisture or oil from the fluid may have adhered to the sensor.
Er07	Flow sensor Temperature sensor Pressure sensor	The cause may be an error or burnout of the flow sensor, temperature sensor, or pressure sensor. Alternatively dust, moisture or oil from the fluid may have adhered to the sensor.
Er08	EEPROM	The cause may be an error in the nonvolatile memory used by the internal microcomputer.

■ Alarm display

If conditions exceed the device's specified range, an alarm message and the instantaneous value are alternately displayed. In order to use this device within an allowable range, change the conditions of the fluid.

Alarm display	Cause
AL01	Flowrate upper limit alarm
AL02	Temperature lower limit alarm
AL03	Flowrate upper limit alarm+Temperature lower limit alarm
AL04	Temperature upper limit alarm
AL05	Flowrate upper limit alarm+Temperature upper limit alarm
AL08	Pressure upper limit alarm
AL09	Flowrate upper limit alarm+Pressure lower limit alarm
AL10	Temperature lower limit alarm+Pressure lower limit alarm
AL11	Flowrate upper limit alarm+Temperature lower limit alarm+Pressure lower limit alarm
AL12	Temperature upper limit alarm+Pressure lower limit alarm
AL13	Flowrate upper limit alarm+Temperature upper limit alarm+Pressure lower limit alarm
AL16	Pressure upper limit alarm
AL17	Flowrate upper limit alarm+Pressure upper limit alarm
AL18	Temperature lower limit alarm+Pressure upper limit alarm
AL19	Flowrate upper limit alarm+Temperature lower limit alarm+Pressure upper limit alarm
AL20	Temperature upper limit alarm+Pressure upper limit alarm
AL21	Flowrate upper limit alarm+Temperature upper limit alarm+Pressure upper limit alarm

Flowrate upper limit alarm: Flowrate speed 45m/s or more.
Temperature lower limit alarm: -15˚C or lower.
Temperature upper limit alarm: 60˚C or more.
Pressure lower limit alarm: -50kPa or lower.
Pressure upper limit alarm: 1000kPa or more.

Chapter 5. SPECIFICATIONS

■ Specifications

Item		Specifications			
		MVF050	MVF080	MVF100	MVF150
Pipe size		50A (2B)	80A (3B)	100A (4B)	150A (6B)
Flowrate measurement range (@23°C for air) (at a pressure of 0.5MPa)		13 to 1280m³/h (normal)	29 to 2826m³/h (normal)	44 to 4352m³/h (normal)	94 to 9364m³/h (normal)
		"Normal" refers to the volumetric flow rate (m³/h) after converting to 0°C, 101.325kPa.			
Applicable gas		Air, Nitrogen, Argon, Oxygen *1, Carbon dioxide, natural gas (LNG base), Methane, Propane, Butane, and other inert gases and mixed gases outside the explosion limit range.			
Volumetric flow rate accuracy (@23°C for air)		2%RD at 74m³/h (normal)	2%RD at 109m³/h (normal)	2%RD at 154m³/h (normal)	2%RD at 283m³/h (normal)
		Differs according to operating pressure. For details, refer to; ☞Tables for specifying volumetric flow rate accuracy (page 20)			
Accuracy after temperature and pressure compensation		When pressure is 0.5MPa ±3.5%RD at 75m³/h (normal) or more	When pressure is 0.5MPa ±3.5%RD at 110m³/h (normal) or more	When pressure is 0.5MPa ±3.5%RD at 157m³/h (normal) or more	When pressure is 0.5MPa ±3.5%RD at 287m³/h (normal) or more
		For conditions other than the above, refer to; ☞Tables for accuracy after temperature and pressure compensation (page 21). Since a gauge pressure sensor is used, atmospheric pressure fluctuation is not included.			
Minimum measurable flow rate (at pressure of 0.1MPa)		8m³/h (normal)	11m³/h (normal)	15m³/h (normal)	32m³/h (normal)
Operating temperature range		-15 to +60°C			
Operating pressure range		0.0 to less than 1.0MPa			
Pressure resistance		1.5MPa			
Operating humidity range		10 to 90%RH (No condensation allowed)			
Flow rate calculation/ output updating cycle		100ms			
Rated power supply		24Vdc			
Current consumption		100mA max.			
Output signal (1 point)		Instantaneous flowrate output: 4 to 20mAdc(Allowable load resistance 600Ω max.) Maximum Current value: 23.2mA			
Integrated pulse output (1 point)		Open collector output Absolute maximum rating: 30Vdc, 20mA max. Pulse weight MVF050: 0.01, 0.1, 1, 10 MVF080/100/150: 0.1, 1, 10, 100 Pulse width Output intervals of 1s or more: 0.5s Output intervals of less than 1s: duty ratio 50%			
Communication function 1		RS-485 interface, Transmission line : 3-wire system Communication distance 300m max., Compatible with Yamatake's products (EST, CMC10G, WEB100) Transmission speed 2400, 4800, 9600, 19200bps Integrated value, instantaneous, value/warning, and setting can be recorded			
Communication function 2		Mini-plug jack for PC Smart Loader connection, used in servicing by the manufacturer.			
Display	Flowrate display	Instantaneous flowrate display: LCD 6 digits Integrated flowrate: LCD 8 digits			
	Instantaneous Flowrate	Display unit MVF050/80/100 : 1 * * * * * m³/h MVF150 : 1 * * * * m³/h			
	Integrated Flowrate	Display unit MVF050 : * * * * * * * * m³(displayed down to the first decimal place) MVF080/100/150 : * * * * * * * * m³ (no decimal point) 00000000 after counting up to 99999999 (For details of setup, refer to ☞MVF Series Communications Functions (CP-SP-1183E)			
	Status display	setting: for servicing by manufacturer. OVER: exceeding the flow rate range			
Gas contacting parts material		Flow passage:SUS304 μF sensor:Silicon, Gold etc., O ring: Type 4D (Viton)			
Convertor material		Aluminum alloy (ADC12)			
Convertor coating		Acrylic resin corrosion resistant coating Coating color: Light beige			
Display glass parts material		Tempered glass: Thickness 10mm			
Mounting direction		(flow direction) Horizontal/Vertical mounting			
Connection type		Wafer connection			
Wiring connection port		Connection port: 2 locations, Connection standard:G1/2 female thread Accessories: 2 water-proof glands attached			
Sealing		(JIS C 0920 and IEC 60529 Water-proof and dust-proof structure on the assumption of outdoor installation)			
Mass(kg)		7	8	10	23

*1: Use for oxygen is possible only for models with oil inhibiting treatment for the gas-contacting parts.

■ Specifying accuracy

See the tables for specifying accuracy on pages 20 and following. The accuracy tables show the ranges when the gas is air. To convert to other application conditions, calculate as shown below.

The Reynolds number (Re) used below is calculated using the formula
$Re = (V \times D)/\nu$.
V: velocity (m/s)
D: typical length (internal diameter of the MVF body(m))
MVF050: 52.5mm, MVF080: 78mm, MVF100: 96.8mm, MVF150: 142mm
ν: kinetic viscosity of the fluid (m^2/s), = μ/ρ
For instance, in the case of air (dry air) at 0°C and 101.3kPa,
Viscosity μ =17.24×10^{-6} Pa·s
Density ρ =$1.293 kg/m^3$
From these conditions, the kinetic viscosity ν =13.35×10^{-6} m^2/s.
Or, in the case of air (dry air) at 23°C and 700kPa,
ν =1.883×10^{-6} m^2/s

As a calculation example, we will use the following conditions:
Installed flowmeter: MVF080
Fluid: air (dry air)
Operating pressure: 700kPa
Fluid temperature: 23°C
Atmospheric pressure: 101.3kPa

We will calculate the following items:
1. Minimum measurable flow rate
2. Maximum measurable flow rate
3. Accuracy after temperature and pressure compensation (examples: for 100 and 150m^3/h (normal))

1. Minimum measurable flow rate (volumetric flow rate (m^3/h) and mass flow rate (m^3/h (normal))

First, the minimum measurable flow speed is determined as the larger of 0.3m/s or the velocity at Re 3500. The velocity at Re 3500 is calculated from the formula for calculating Re:
$V = Re \times \nu / D$.

Here, if Re = 3500, $\nu = 1.883 \times 10^{-6} m^2/s$, and $D = 78 \times 10^{-3}$m,
$V = 3500 \times 1.883 \times 10^{-6} / (78 \times 10^{-3}) = 0.08$m/s.
Since a velocity of 0.08m/s at Re 3500 is less than 0.3m/s, the minimum measurable velocity is 0.3m/s.

Now, the minimum measurable volumetric flow rate can be calculated as
Qactual (m^3/h) = S × V × 3600 = 5.2.
S: flow path cross-section of MVF080 (m^2) = $(78 \times 10^{-3})^2 \times \pi/4$
V: velocity (m/s) = 0.3
Therefore, volumetric flow rate can be measured down to 5.2m^3/h.
Next, we can calculate the minimum mass flow rate Qnormal (m^3/h (normal)) at 0°C and one atmospheric pressure, with temperature and pressure compensation.

$$\text{Qnormal } (m^3/h(\text{normal})) = 5.2 \times \underbrace{((273+0)/(273+23))}_{\substack{\text{Amount of temperature}\\ \text{compensation}}} \times \underbrace{((101.3+700)/101.3)}_{\substack{\text{Amount of pressure}\\ \text{compensation}}} = 38$$

Therefore, mass flow rate can be measured starting from a minimum of $38m^3/h$ (normal).

2. Maximum measurable flow rate (volumetric flow rate (m^3/h) and mass flow rate (m^3/h (normal))

MVF flowmeters can measure velocity up to 30m/s.

The volumetric flow rate Qactual (m^3/h) at velocity 30m/s is determined by Qactual (m^3/h) = S × V × 3600 = 516.

S: flow path cross-section of MVF080 (m^2) = $(78 \times 10^{-3})^2 \times \pi/4$

V: velocity (m/s) = 30

The volumetric flow rate can be measured up to $516m^3/h$.

Next, we can calculate the mass flow rate at 0°C and one atmospheric pressure, with temperature and pressure compensation, by

$$\text{Qnormal } (m^3/h(\text{normal})) = 516 \times \underbrace{((273+0)/(273+23))}_{\substack{\text{Amount of temperature}\square\\ \text{compensation}}} \times \underbrace{((101.3+700)/101.3)}_{\substack{\text{Amount of pressure}\square\\ \text{compensation}}} = 3765$$

Mass flow rate can be measured up to $3765m^3/h$ (normal).

3. Accuracy after temperature and pressure compensation

As an example, we will calculate the accuracy after temperature and pressure compensation at $100m^3/h$ and $150m^3/h$ (normal), using the following formula:

$$\underset{\text{compensation}}{\text{Accuracy after}\square}(\%RD) = \sqrt{(\underset{\text{rate accuracy}}{\text{volumetric flow}}(\%RD)^2 + \underset{\text{accuracy}}{\text{temperature}}(\%RD)^2 + \underset{\text{accuracy}}{\text{pressure}}(\%RD)^2)}$$

Temperature and pressure sensor accuracy is as follows:

Temperature measurement accuracy: ±2% RD (absolute temperature base)

Pressure accuracy (% RD) = pressure measurement accuracy / (fluid pressure (MPa) + 0.1013(MPa))

In this case, the pressure measurement accuracy is 1%FS in the 0 to 1MPa range.

In order to calculate the volumetric flow rate accuracy, Re is first calculated from the mass flow rate (m^3/h, normal).

The steps of the calculation are: mass flow rate → volumetric flow rate → velocity → Re.

Mass flow rate → volumetric flow rate calculation

Qactual (m^3/h) = 100 × ((273+23) / (273+0) × (101.3 / (101.3 + 700)) = 13.7

Volumetric flow rate → Velocity calculation

Velocity V(m/s) = Qactual(m^3/h) / S / 3600 = 13.7 / $((78 \times 10^{-3})^2 \times \pi/4 / 3600 = 0.8$

S: flow path cross-section of MVF080 (m^2) = $(78 \times 10^{-3})^2 \times \pi/4$

Velocity → Re calculation

Re = (V × D)/ $\nu = 0.8 \times 78 \times 10^{-3} / 1.883 \times 10^{-6} = 33139$

V: velocity (m/s) = 0.8

D: internal diameter of the MVF body (m); for MVF080, D = 78mm

ν: kinetic viscosity of fluid (m^2/s)

For dry air, 23°C and 700kPa, $\nu = 1.883 \times 10^{-6} m^2/s$

Volumetric flow rate accuracy is checked by the Re value.

With Re = 33139 (flow rate = 0.8m/s), since the velocity is 0.5m/s or more and Re is in the 10000-35000 range, the volumetric flow rate accuracy is ±4% RD.

☞● Specifying volumetric flow rate accuracy (below)

Volumetric flow rate accuracy = 4% RD

Temperature accuracy = 2% RD

Pressure accuracy = 0.01 / fluid pressure (MPa) = 0.01/0.7 = 1.4% DR

Based on these conditions,

$$\text{The accuracy after temperature compensation} = \sqrt{(4\%)^2 + (2\%)^2 + (1.4\%)^2} = 4.7\%\text{RD}$$

At 100m^3/h (normal), the accuracy is 4.7% RD.

The calculation is similar for 150m^3/h (normal).

Re = 49517 (velocity = 1.2m/s).

Since Re is more than 35000, the volumetric flow rate accuracy is ±2% RD.

☞● Specifying volumetric flow rate accuracy (below)

Volumetric flow rate accuracy = 2% RD

Temperature accuracy = 2% RD

Pressure accuracy = 0.01 / fluid pressure (MPa) = 0.01/0.7 = 1.4% DR

Based on these conditions,

$$\text{The accuracy after temperature compensation} = \sqrt{(2\%)^2 + (2\%)^2 + (1.4\%)^2} = 3.2\%\text{RD}$$

At 150m^3/h (normal), the accuracy is 3.2% RD.

● Specifying volumetric flow rate accuracy

The volumetric flow rate accuracy is specified as follows:

- MVF50 (pipe size 50A)
  - · 4% RD when velocity is 0.5m/s or more, and Re is 15000 to less than 35000.
  - · 2% RD when Re is 35000 or more.
- MVF80 (pipe size 80A)
  - · 4% RD when velocity is 0.5m/s or more, and Re is 10000 to less than 35000.
  - · 2% RD when Re is 35000 or more.
- MVF100 (pipe size 100A)
  - · 4% RD when velocity is 0.5m/s or more, and Re is 10000 to less than 40000.
  - · 2% RD when Re is 40000 or more.
- MVF150 (pipe size 150A)
  - · 4% RD when velocity is 0.5m/s or more, and Re is 10000 to less than 50000.
  - · 2% RD when Re is 50000 or more.

■ Tables for specifying volumetric flow rate accuracy (in air)

Unit of flow rate: m^3/h (actual @ 23°C)

Accuracy differs according to operating pressure and flow rate ranges.

● MVF050 (Pipe size 50A)

Operating pressure (kPa)	Minimum measurable flow rate Q min	Accuracy		
		±Q min	±4%RD	±2%RD
10	7.3	7.3 ≤ Q ≤ 31	31 < Q < 73	73 ≤ Q ≤ 234
20	6.7	6.7 ≤ Q ≤ 29	29 < Q < 67	67 ≤ Q ≤ 234
30	6.2	6.2 ≤ Q ≤ 27	27 < Q < 62	62 ≤ Q ≤ 234
40	5.8	5.8 ≤ Q ≤ 25	25 < Q < 58	58 ≤ Q ≤ 234
50	5.4	5.4 ≤ Q ≤ 23	23 < Q < 54	54 ≤ Q ≤ 234
60	5.0	5.0 ≤ Q ≤ 22	22 < Q < 50	50 ≤ Q ≤ 234
70	4.7	4.7 ≤ Q ≤ 20	20 < Q < 47	47 ≤ Q ≤ 234
80	4.5	4.5 ≤ Q ≤ 19	19 < Q < 45	45 ≤ Q ≤ 234
90	4.3	4.3 ≤ Q ≤ 18	18 < Q < 43	43 ≤ Q ≤ 234
100	4.0	4.0 ≤ Q ≤ 17	17 < Q < 40	40 ≤ Q ≤ 234
200	2.7	2.7 ≤ Q ≤ 12	12 < Q < 27	27 ≤ Q ≤ 234
300	2.3	2.3 ≤ Q ≤ 9	9 < Q < 20	20 ≤ Q ≤ 234
400	2.3	2.3 ≤ Q ≤ 7	7 < Q < 16	16 ≤ Q ≤ 234
500	2.3	2.3 ≤ Q ≤ 6	6 < Q < 14	14 ≤ Q ≤ 234
600	2.3	2.3 ≤ Q ≤ 5	5 < Q < 12	12 ≤ Q ≤ 234
700	2.3	2.3 ≤ Q ≤ 4	4 < Q < 10	10 ≤ Q ≤ 234
800	2.3	2.3 ≤ Q ≤ 4	4 < Q < 9	9 ≤ Q ≤ 234
900	2.3	2.3 ≤ Q ≤ 4	4 < Q < 8	8 ≤ Q ≤ 234
980	2.3	2.3 ≤ Q ≤ 4	4 < Q < 8	8 ≤ Q ≤ 234

● MVF080 (Pipe size 80A)

Operating pressure (kPa)	Minimum measurable flow rate Q min	Accuracy		
		±Q min	±4%RD	±2%RD
10	10.9	10.9 ≤ Q ≤ 31	31 < Q < 109	109 ≤ Q ≤ 516
20	10.0	10.0 ≤ Q ≤ 28	28 < Q < 100	100 ≤ Q ≤ 516
30	9.2	9.2 ≤ Q ≤ 26	26 < Q < 92	92 ≤ Q ≤ 516
40	8.6	8.6 ≤ Q ≤ 24	24 < Q < 86	86 ≤ Q ≤ 516
50	8.0	8.0 ≤ Q ≤ 23	23 < Q < 80	80 ≤ Q ≤ 516
60	7.5	7.5 ≤ Q ≤ 21	21 < Q < 75	75 ≤ Q ≤ 516
70	7.1	7.1 ≤ Q ≤ 20	20 < Q < 71	71 ≤ Q ≤ 516
80	6.7	6.7 ≤ Q ≤ 19	19 < Q < 67	67 ≤ Q ≤ 516
90	6.3	6.3 ≤ Q ≤ 18	18 < Q < 63	63 ≤ Q ≤ 516
100	6.0	6.0 ≤ Q ≤ 17	17 < Q < 60	60 ≤ Q ≤ 516
200	5.2	5.2 ≤ Q ≤ 11	11 < Q < 40	40 ≤ Q ≤ 516
300	5.2	5.2 ≤ Q ≤ 9	9 < Q < 30	30 ≤ Q ≤ 516
400	5.2	5.2 ≤ Q ≤ 9	9 < Q < 24	24 ≤ Q ≤ 516
500	5.2	5.2 ≤ Q ≤ 9	9 < Q < 20	20 ≤ Q ≤ 516
600	5.2	5.2 ≤ Q ≤ 9	9 < Q < 17	17 ≤ Q ≤ 516
700	5.2	5.2 ≤ Q ≤ 9	9 < Q < 15	15 ≤ Q ≤ 516
800	5.2	5.2 ≤ Q ≤ 9	9 < Q < 13	13 ≤ Q ≤ 516
900	5.2	5.2 ≤ Q ≤ 9	9 < Q < 12	12 ≤ Q ≤ 516
980	5.2	5.2 ≤ Q ≤ 9	9 < Q < 11	11 ≤ Q ≤ 516

● MVF100 (Pipe size 100A)

Operating pressure (kPa)	Minimum measurable flow rate Q min	Accuracy		
		±Q min	±4%RD	±2%RD
10	13.5	13.5 ≤ Q ≤ 39	39 < Q < 154	154 ≤ Q ≤ 795
20	12.4	12.4 ≤ Q ≤ 35	35 < Q < 141	141 ≤ Q ≤ 795
30	11.4	11.4 ≤ Q ≤ 33	33 < Q < 131	131 ≤ Q ≤ 795
40	10.6	10.6 ≤ Q ≤ 30	30 < Q < 121	121 ≤ Q ≤ 795
50	9.9	9.9 ≤ Q ≤ 28	28 < Q < 113	113 ≤ Q ≤ 795
60	9.3	9.3 ≤ Q ≤ 27	27 < Q < 106	106 ≤ Q ≤ 795
70	8.8	8.8 ≤ Q ≤ 25	25 < Q < 100	100 ≤ Q ≤ 795
80	8.3	8.3 ≤ Q ≤ 24	24 < Q < 95	95 ≤ Q ≤ 795
90	7.9	7.9 ≤ Q ≤ 22	22 < Q < 90	90 ≤ Q ≤ 795
100	7.9	7.9 ≤ Q ≤ 21	21 < Q < 85	85 ≤ Q ≤ 795
200	7.9	7.9 ≤ Q ≤ 14	14 < Q < 57	57 ≤ Q ≤ 795
300	7.9	7.9 ≤ Q ≤ 13	13 < Q < 43	43 ≤ Q ≤ 795
400	7.9	7.9 ≤ Q ≤ 13	13 < Q < 34	34 ≤ Q ≤ 795
500	7.9	7.9 ≤ Q ≤ 13	13 < Q < 29	29 ≤ Q ≤ 795
600	7.9	7.9 ≤ Q ≤ 13	13 < Q < 24	24 ≤ Q ≤ 795
700	7.9	7.9 ≤ Q ≤ 13	13 < Q < 21	21 ≤ Q ≤ 795
800	7.9	7.9 ≤ Q ≤ 13	13 < Q < 19	19 ≤ Q ≤ 795
900	7.9	7.9 ≤ Q ≤ 13	13 < Q < 17	17 ≤ Q ≤ 795
980	7.9	7.9 ≤ Q ≤ 13	13 < Q < 16	16 ≤ Q ≤ 795

● MVF150 (Pipe size 150A)

Operating pressure (kPa)	Minimum measurable flow rate Q min	Accuracy		
		±Q min	±4%RD	±2%RD
10	19.8	19.8 ≤ Q≤ 56	56 < Q < 282	282 ≤ Q ≤ 1710
20	18.1	18.1 ≤ Q ≤ 52	52 < Q < 259	259 ≤ Q ≤ 1710
30	17.1	17.1 ≤ Q ≤ 48	48 < Q < 239	239 ≤ Q ≤ 1710
40	17.1	17.1 ≤ Q ≤ 44	44 < Q < 222	222 ≤ Q ≤ 1710
50	17.1	17.1 ≤ Q ≤ 42	42 < Q < 208	208 ≤ Q ≤ 1710
60	17.1	17.1≤ Q ≤ 39	39 < Q < 195	195 ≤ Q ≤ 1710
70	17.1	17.1 ≤ Q ≤ 37	37 < Q < 184	184 ≤ Q ≤ 1710
80	17.1	17.1 ≤ Q ≤ 35	35 < Q < 173	173 ≤ Q ≤ 1710
90	17.1	17.1 ≤ Q ≤ 33	33 < Q < 164	164 ≤ Q ≤ 1710
100	17.1	17.1 ≤ Q ≤ 31	31 < Q < 156	156 ≤ Q ≤ 1710
200	17.1	17.1 ≤ Q ≤ 29	29 < Q < 104	104 ≤ Q ≤ 1710
300	17.1	17.1 ≤ Q ≤ 29	29 < Q < 78	78 ≤ Q ≤ 1710
400	17.1	17.1 ≤ Q ≤ 29	29 < Q < 63	63 ≤ Q ≤ 1710
500	17.1	17.1 ≤ Q ≤ 29	29 < Q < 52	52 ≤ Q ≤ 1710
600	17.1	17.1 ≤ Q ≤ 29	29 < Q < 45	45 ≤ Q ≤ 1710
700	17.1	17.1 ≤ Q ≤ 29	29 < Q < 39	39 ≤ Q ≤ 1710
800	17.1	17.1 ≤ Q ≤ 29	29 < Q < 35	35 ≤ Q ≤ 1710
900	17.1	17.1 ≤ Q ≤ 29	29 < Q < 31	31 ≤ Q ≤ 1710
980	17.1	17.1 ≤ Q ≤ 29	29 < Q < 29	29 ≤ Q ≤ 1710

■ Tables for accuracy after temperature and pressure compensation (in air)

Unit of flow rate: m^3/h (actual @ 23°C)

Accuracy differs according to operating pressure and flow rate range.

● MVF050 (Pipe size 50A)

Operating pressure (MPa)	Minimum measurable flow rate Q min	Accuracy		
0.10	7.4	±Qmin	±6.7% RD	±5.7% RD
		7.4 ≤ Q ≤ 32	32 < Q < 74	74 ≤ Q ≤ 428
0.15	7.4	±Qmin	±6.0% RD	±4.9% RD
		7.4 ≤ Q ≤ 32	32 < Q < 74	74 ≤ Q ≤ 535
0.20	7.4	±Qmin	±5.6% RD	±4.4% RD
		7.4 ≤ Q ≤ 32	32 < Q < 74	74 ≤ Q ≤ 641
0.30	8.5	±Qmin	±5.1% RD	±3.8% RD
		8.5 ≤ Q ≤ 32	32 < Q < 74	74 ≤ Q ≤ 854
0.40	10.7	±Qmin	±4.9% RD	±3.5% RD
		10.7 ≤ Q ≤ 32	32 < Q < 74	74 ≤ Q ≤ 1067
0.50	12.8	±Qmin	±4.8% RD	±3.3% RD
		12.8 ≤ Q ≤ 32	32 < Q < 74	74 ≤ Q ≤ 1280
0.60	14.9	±Qmin	±4.7% RD	±3.2% RD
		14.9 ≤ Q ≤ 32	32 < Q < 74	74 ≤ Q ≤ 1493
0.70	17.1	±Qmin	±4.6% RD	±3.1% RD
		17.1 ≤ Q ≤ 32	32 < Q < 74	74 ≤ Q ≤ 1706
0.80	19.2	±Qmin	±4.6% RD	±3.0% RD
		19.2 ≤ Q ≤ 32	32 < Q < 74	74 ≤ Q ≤ 1919
0.90	21.3	±Qmin	±4.6% RD	±3.0% RD
		21.3 ≤ Q ≤ 36	36 < Q < 74	74 ≤ Q ≤ 2131
0.98	23.0	±Qmin	±4.6% RD	±3.0% RD
		23.0 ≤ Q ≤ 38	38 < Q < 74	74 ≤ Q ≤ 2302

● MVF080 (Pipe size 80A)

Operating pressure (MPa)	Minimum measurable flow rate Q min	Accuracy		
0.10	11.0	±Qmin	±6.7% RD	±5.7% RD
		11.0 ≤ Q ≤ 31	31 < Q < 110	110 ≤ Q ≤ 946
0.15	11.8	±Qmin	±6.0% RD	±4.9% RD
		11.8 ≤ Q ≤ 31	31 < Q < 110	110 ≤ Q ≤ 1181
0.20	14.2	±Qmin	±5.6% RD	±4.4% RD
		14.2 ≤ Q ≤ 31	31 < Q < 110	110 ≤ Q ≤ 1416
0.30	18.9	±Qmin	±5.1% RD	±3.8% RD
		18.9 ≤ Q ≤ 31	31 < Q < 110	110 ≤ Q ≤ 1886
0.40	23.6	±Qmin	±4.9% RD	±3.5% RD
		23.6 ≤ Q ≤ 39	39 < Q < 110	110 ≤ Q ≤ 2355
0.50	28.3	±Qmin	±4.8% RD	±3.3% RD
		28.3 ≤ Q ≤ 47	47 < Q < 110	110 ≤ Q ≤ 2825
0.60	33.0	±Qmin	±4.7% RD	±3.2% RD
		33.0 ≤ Q ≤ 55	55 < Q < 110	110 ≤ Q ≤ 3295
0.70	37.6	±Qmin	±4.6% RD	±3.1% RD
		37.6 ≤ Q ≤ 63	63 < Q < 110	110 ≤ Q ≤ 3765
0.80	42.3	±Qmin	±4.6% RD	±3.0% RD
		42.3 ≤ Q ≤ 71	71 < Q < 110	110 ≤ Q ≤ 4235
0.90	47.0	±Qmin	±4.6% RD	±3.0% RD
		47.0 ≤ Q ≤ 78	78 < Q < 110	110 ≤ Q ≤ 4705
0.98	50.8	±Qmin	±4.6% RD	±3.0% RD
		50.8 ≤ Q ≤ 85	85 < Q < 110	110 ≤ Q ≤ 5081

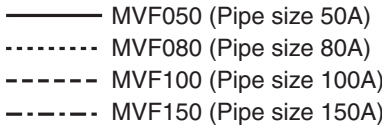
● MVF100 (Pipe size 100A)

Operating pressure (MPa)	Minimum measurable flow rate Q min	Accuracy		
0.10	14.6	±Qmin	±6.7% RD	±5.7% RD
		14.6 ≤ Q ≤ 39	39 < Q < 156	156 ≤ Q ≤ 1457
0.15	18.2	±Qmin	±6.0% RD	±4.9% RD
		18.2 ≤ Q ≤ 39	39 < Q < 156	156 ≤ Q ≤ 1819
0.20	21.8	±Qmin	±5.6% RD	±4.4% RD
		21.8 ≤ Q ≤ 39	39 < Q < 156	156 ≤ Q ≤ 2180
0.30	29.0	±Qmin	±5.1% RD	±3.8% RD
		29.0 ≤ Q ≤ 48	48 < Q < 156	156 ≤ Q ≤ 2904
0.40	36.3	±Qmin	±4.9% RD	±3.5% RD
		36.3 ≤ Q ≤ 60	60 < Q < 156	156 ≤ Q ≤ 3628
0.50	43.5	±Qmin	±4.8% RD	±3.3% RD
		43.5 ≤ Q ≤ 73	73 < Q < 156	156 ≤ Q ≤ 4351
0.60	50.7	±Qmin	±4.7% RD	±3.2% RD
		50.7 ≤ Q ≤ 85	85 < Q < 156	156 ≤ Q ≤ 5075
0.70	58.0	±Qmin	±4.6% RD	±3.1% RD
		58.0 ≤ Q ≤ 97	97 < Q < 156	156 ≤ Q ≤ 5799
0.80	65.2	±Qmin	±4.6% RD	±3.0% RD
		65.2 ≤ Q ≤ 109	109 < Q < 156	156 ≤ Q ≤ 6522
0.90	72.5	±Qmin	±4.6% RD	±3.0% RD
		72.5 ≤ Q ≤ 121	121 < Q < 156	156 ≤ Q ≤ 7246
0.98	78.2	±Qmin	±4.6% RD	±3.0% RD
		78.2 ≤ Q ≤ 130	130 < Q < 156	156 ≤ Q ≤ 7825

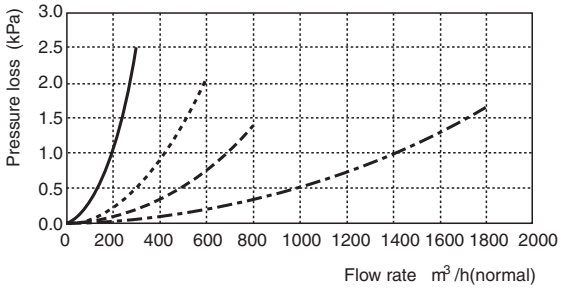
● MVF150 (Pipe size 150A)

Operating pressure (MPa)	Minimum measurable flow rate Q min	Accuracy		
0.10	31.3	±Qmin	±6.7% RD	±5.7% RD
		31.3 ≤ Q ≤ 57	57 < Q < 286	286 ≤ Q ≤ 3135
0.15	39.1	±Qmin	±6.0% RD	±4.9% RD
		39.1 ≤ Q ≤ 65	65 < Q < 286	286 ≤ Q ≤ 3913
0.20	46.9	±Qmin	±5.6% RD	±4.4% RD
		46.9 ≤ Q ≤ 78	78 < Q < 286	286 ≤ Q ≤ 4692
0.30	62.5	±Qmin	±5.1% RD	±3.8% RD
		62.5 ≤ Q ≤ 104	104 < Q < 286	286 ≤ Q ≤ 6249
0.40	78.1	±Qmin	±4.9% RD	±3.5% RD
		78.1 ≤ Q ≤ 130	130 < Q < 286	286 ≤ Q ≤ 7806
0.50	93.6	±Qmin	±4.8% RD	±3.3% RD
		93.6 ≤ Q ≤ 156	156 < Q < 286	286 ≤ Q ≤ 9364
0.60	109.2	±Qmin	±4.7% RD	±3.2% RD
		109.2 ≤ Q ≤ 182	182 < Q < 286	286 ≤ Q ≤ 10921
0.70	124.8	±Qmin	±4.6% RD	±3.1% RD
		124.8 ≤ Q ≤ 208	208 < Q < 286	286 ≤ Q ≤ 12478
0.80	140.4	±Qmin	±4.6% RD	±3.0% RD
		140.4 ≤ Q ≤ 234	234 < Q < 286	286 ≤ Q ≤ 14035
0.90	155.9	±Qmin	±4.6% RD	±3.0% RD
		155.9 ≤ Q ≤ 260	260 < Q < 286	286 ≤ Q ≤ 15593
0.98	168.4	±Qmin	±4.6% RD	±3.0% RD
		168.4 ≤ Q ≤ 281	281 < Q < 286	286 ≤ Q ≤ 16838

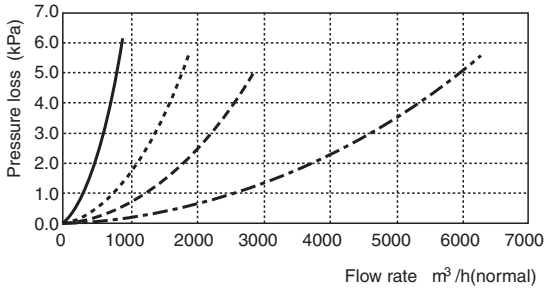
■ Pressure loss



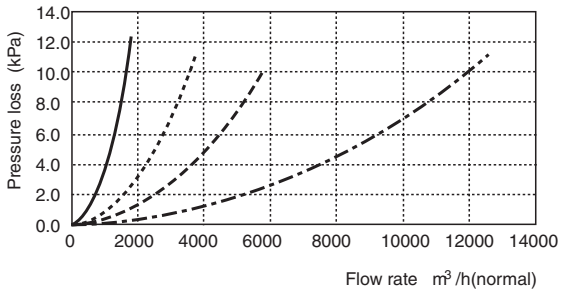
● **Inlet pressure 0.01MPa**



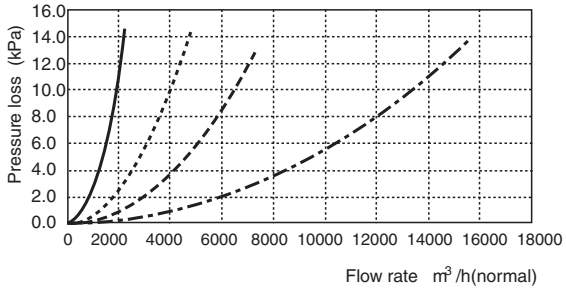
● **Inlet pressure 0.3MPa**



● **Inlet pressure 0.7MPa**



● **Inlet pressure 0.9MPa**



When the MVF is used for a gas other than air, multiply by the appropriate specific gravity below.

Specific gravity of each gas (when air is 1.0)	
Argon	1.38
Carbon dioxide	1.53
Oxygen	1.11
Natural gas (LNG base)	0.64
Methane 100%	0.56
Propane 100%	1.56
Butane 100%	2.08

Example)

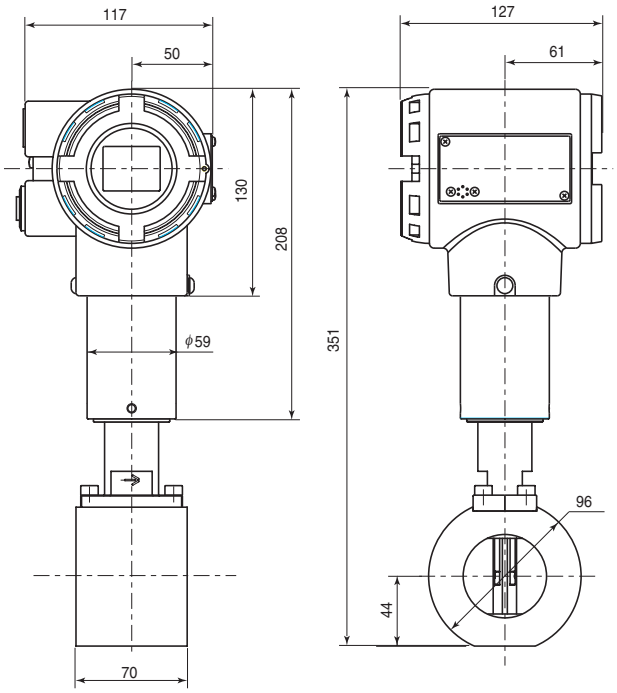
For the MVF150, with a inlet pressure of 0.9MPa and a flow rate of 6000m³/h (normal), the pressure loss of natural gas can be calculated as follows:

Using the graph for 0.9MPa primary pressure, the pressure loss is 2kPa at a flow rate of 6000m³/h (normal). When this is multiplied by the specific gravity of natural gas, 0.64, the pressure loss is:

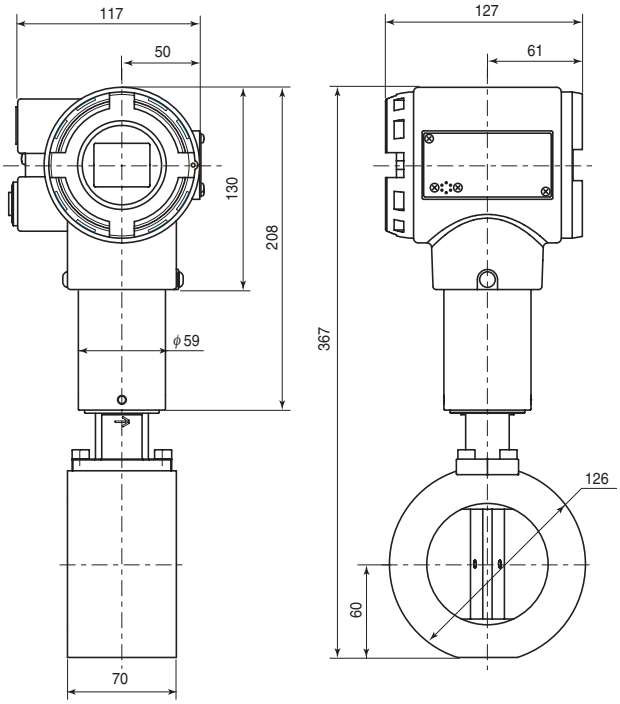
2kPa × 0.64 = 1.28kPa

■ External dimensions Unit : mm

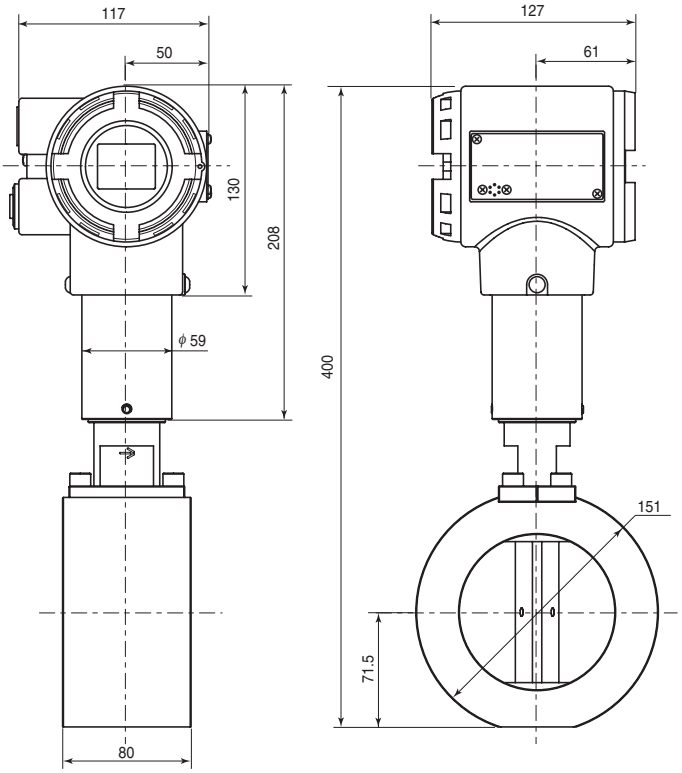
● MVF050 (Pipe size 50A)



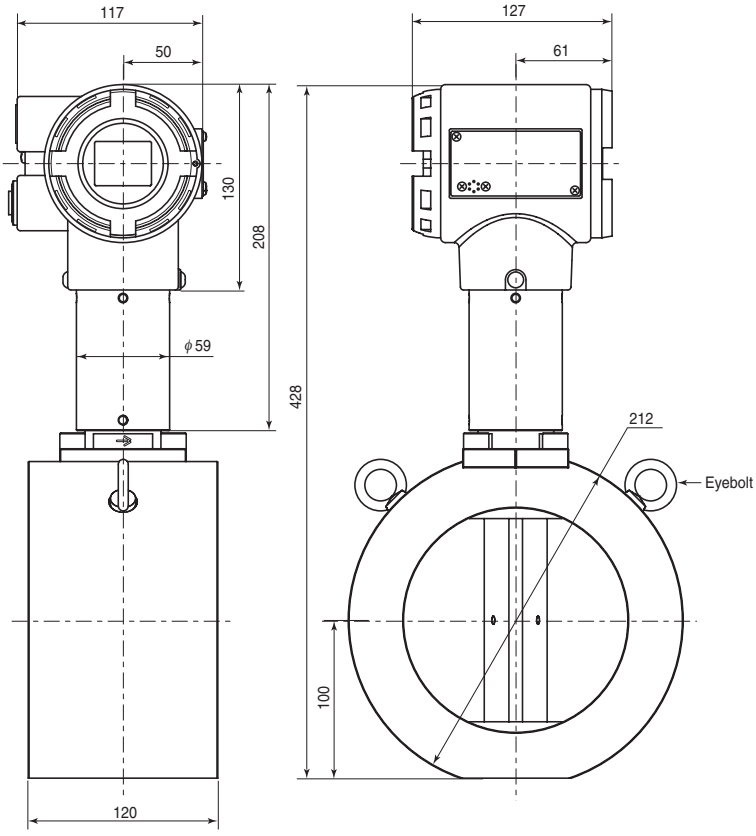
● MVF080 (Pipe size 80A)



● **MVF100 (Pipe size 100A)**



● **MVF150 (Pipe size 150A)**



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Revision History

Printed date	Manual Number	Edition	Revised pages	Description
Sep. 2005	**CP-SP-1190E**	**1st Edition**		
Feb. 2006		**2nd Edition**	ii, iii	Warning about disassembling added to WARNING section.Order of CAUTION items changed.
			1	System section: “Integrated pulse output” changed to “Pulse output.”
			4	"Rotary switch" changed to "Station address setting switch.". “DIP switch” changed to "Communications parameters switch."
			5	Warning about disassembling added to WARNING section. Caution about vibration added to CAUTION section.
			9	Description of "Note" removed. Description of mounting method added. "Flange shape" item moved from page 10.
			10	"Mounting the gasket" moved from page 9. Subject changed to "Dimensions of gasket."
			11 to 14	Description of "Wiring" section completely changed. Old pages are 11 to 13.
			15, 16	Old pages are 14 and 15.
			17	"Contact rating" changed to "Absolute maximum rating." Pulse width added to pulse output. Old page is 16.
			18	"One atmospheric pressure" changed to "101.3kPa." Old page is 17.
			19 to 26	Old pages are 18 to 25.
June 2007		**3rd Edition**	13	● Wiring connection example changed.
			17	■ Specifications "Flowrate measurement range, "Volumetric flow rateaccuracy" added to (@23°C for air)". "Volumetric flow rate accuracy", "Accuracy after temperature and pressure compensation" changed.
			19	"Pressure accuracy (% RD)" added to " + 0.1013(MPa)".
			21	■ Tables for specifying volumetric flow rate accuracy (in air) changed.
			22	■ Tables for accuracy after temperature and pressure compensation (in air) changed.

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